

# 1.6 Graphical Transformations

Obj: 1. Algebraically & graphically represent translations, reflections, stretches & shrinks of fns.

$f(x) = -x^2$

Inside:	$g(x) = (x+2)^2$	horizontal
Outside:	$h(x) = x^2 + 2$	vertical

Addition / Subtraction:  
translation

Multiplication / Division  
stretch or compression  
shrink

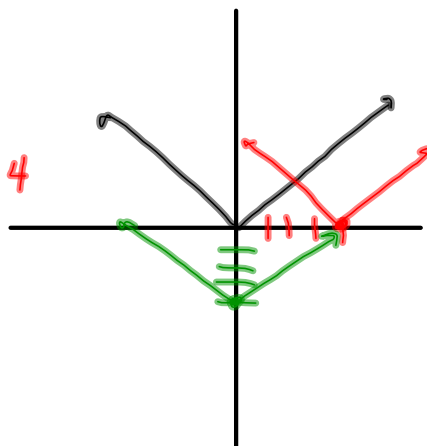
Negative  
reflection

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$$y = |x|$$

$$y = |x-4| \quad \text{h. trans. right 4}$$

$$y = |x| - 4 \quad \text{v. trans. down 4}$$



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$f(x) = x^2$   
 $g(x) = 2x^2$  v. str. by 2  
 $h(x) = \frac{1}{2}x^2$  v. comp by  $\frac{1}{2}$   
 $j(x) = (3x)^2$  h. comp by  $\frac{1}{3}$   
 $k(x) = (\frac{1}{3}x)^2$  h. str. by 3

The graph shows a coordinate plane with a parabola opening upwards. The parent function  $f(x) = x^2$  is shown in black. Four other parabolas are shown in different colors, each with arrows indicating the direction of the transformation from the parent function: a blue parabola for  $g(x) = 2x^2$  (vertical stretch), a green parabola for  $h(x) = \frac{1}{2}x^2$  (vertical compression), a red parabola for  $j(x) = (3x)^2$  (horizontal compression), and an orange parabola for  $k(x) = (\frac{1}{3}x)^2$  (horizontal stretch).

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Stretches / Compressions :

Horizontal: if  $c > 1$  : compression by  $\frac{1}{c}$   
 ex:  $(3x)^2$

if  $c < 1$  : stretch by  $\frac{1}{c}$   
 ex:  $(\frac{1}{2}x)^2$   
 ex:  $(\frac{1}{3}x)^2$  h. comp. by  $\frac{1}{3}$   
 (Note: A blue arrow points from the  $\frac{1}{3}$  in the example to the word "comp.")

Vertical : if  $c > 1$  : stretch  
 ex:  $4x^2$

if  $c < 1$  : compression

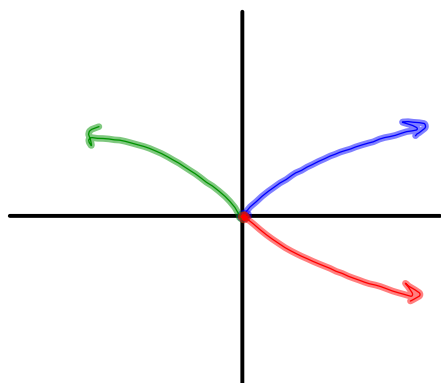
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# Reflections

$$f(x) = \sqrt{x}$$

$$g(x) = \sqrt{-x} \text{ horiz. refl. over } y\text{-axis}$$

$$h(x) = -\sqrt{x} \text{ vert. refl. over } x\text{-axis}$$



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$$f(x) = x^2$$

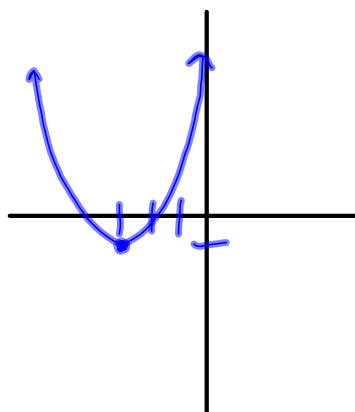
$$g(x) = (2x+6)^2 - 1$$

down 1

h. comp  
by  $\frac{1}{2}$

$$[2(x+3)]^2 - 1$$

left 3



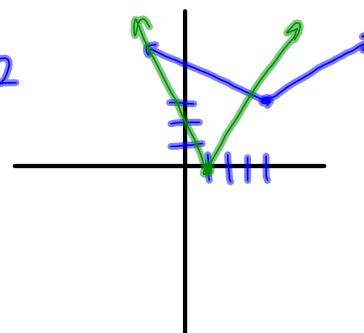
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$$f(x) = |x|$$

$$g(x) = \left| \frac{1}{2}x - 2 \right| + 3$$

$$\left| \frac{1}{2}(x-4) \right| + 3$$

h. str. by 2  
right 4  
up 3



$$h(x) = 3|-x+1|$$

v. str.  
by 3

$$3|-1(x-1)|$$

refl.  
over  
y axis

right one

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